Chapter 8
Coating Application

8-1. Introduction

a. Transferring coating materials from the can to the substrate can be accomplished in several ways. Application methods can range from simple brush and roller to sophisticated spraying. All application methods have inherent advantages and limitations.

b. The choice of an application method depends on the type of coating to be applied, the type and size of surface to be coated, and governing environmental regulations. Contracts will either specify the application method to be used or will permit the contractor to choose a method. However, the consistency of some coatings may dictate a particular method. For example, coatings that are excessively viscous may not permit effective application by spray; or a low viscous coating may only be effectively applied by spray. Either the specifications or the manufacturer's instructions usually will indicate the preferred application method.

8-2. Methods of Coating Application

There are various methods of coating application, including brush application, roller application, conventional spray, high volume-low pressure spray, airless spray, plural component spray, and electrostatic spray. The technologies, techniques, advantages and limitations, equipment, typical coating types involved, and safety considerations for each type of application method will be discussed.

a. Brush application.

(1) There are a variety of brush sizes, shapes, bristle types, and uses. The brush most commonly used for structural steel and similar substrate applications is the conventional wall brush. Oval brushes are commonly used for structural and marine applications, particularly around irregular surfaces such as rivets, boltheads, piping, railing, and similar areas. Widths for the conventional wall brush vary from 25.4 to 152.4 mm (1 to 6 in.), but the most commonly used size is 101.62 mm (4 in.) The two types of bristles used in brush assemblies are synthetic (nylon) fibers and natural (hog) bristle fibers. Synthetic bristles have excellent abrasion resistance when coatings are applied to rough, uneven steel; concrete; and masonry surfaces. Although not affected by most solvents, coatings containing such strong solvents as ketones may affect the synthetic fibers. Natural (hog) bristles, although more expensive and water sensitive, provide the best leveling application characteristics and strong solvent resistance. Proper brush and bristle selection for a specific coating application is imperative for a quality application.

(2) Good brush loading and coating distribution techniques will provide an even application free of laps, runs, drips, and other unacceptable finish characteristics. The brush should be held lightly but firmly, and the paint should be spread over the surface with moderate, even pressure by stroking in one direction, followed by stroking at right angles to the previous coat.

(3) An advantage of brush application is the ability to stripe coat. In many instances, brushing difficult areas (e.g., edges, rivets, corners, boltheads, and welds) prior to the application of a general spray coat is recommended; this process is known as striping. Striping is performed to assure adequate coverage and thickness of the applied coating for areas that are difficult to coat properly by general spray application alone. However, brushing, including brush striping, is not recommended for application of vinyl zinc-rich and epoxy zinc-rich coatings because the zinc must be kept in suspension during application. This is accomplished using agitators in the spray pot or pump. Another advantage of brush application is that it aids in thorough wetting of the substrate, particularly on surfaces that are porous.

(4) Limitations of brush application are that it is slow and tedious, and it may not produce a uniform coating thickness. Brush application of a coating is not practical for large surfaces, and it may leave unsightly brush marks with coatings that do not level well. Brush application of certain coatings, such as high-solids and fast-drying coatings, is difficult and generally is not recommended.

(5) Oil-based and waterborne coatings typically are the most common coating types applied by brush, and their application characteristics are considered good to excellent. The oil-based, slow-drying paint should be brushed out thoroughly to work the coating into cracks, crevices, or other irregular surfaces. Faster drying paints (waterborne) should be brushed out quickly and evenly; otherwise, overbrushing will leave brush marks as the paint dries.

b. Roller application.

(1) The roller assembly consists of a cover and core. Roller covers vary in diameter, length, type of fabric, and fiber length (nap). The 38.1-mm (1-1/2-in.) diameter and 228.6-mm (9-in.) length is the most common size. Polyester, nylon, mohair, and lambskin are typical cover fabrics. Selection of fabric and fiber length depends on the type of coating and the condition of the surface. Woven

fabrics shed fewer lint particles, so they typically are designated for all coatings, especially gloss coating. In addition, longer fibers hold more coating, but they do not provide as smooth a finish. The length of fiber used on steel surfaces varies from 6.35 to 19.05 mm (1/4 to 3/4 in.). Additionally, the roller core must be resistant to strong solvents when applying epoxies, vinyls, urethanes, and similar materials. There are three special types of rollers, including the pipe roller, fence roller, and pressure roller.

(a) The pipe roller is constructed of two to five narrow rollers on a single spring spindle. The rollers readily conform to contoured surfaces, such as piping. The size of the pipe determines the number of segments required, and the threaded handle accommodates the use of an extension pole.

(b) Fence rollers require roller covers with extra long nap (31.75 mm [1-1/4 in.]). These covers enable rapid coating of wire fence from one side because the long nap surrounds the fence wire and coats it on both sides concurrently.

(c) A pressure roller permits continuous coating by steadily supplying coating from a pressurized tank to directly inside the roller. The roller cover is made of a perforated core that enables a coating to pass from inside the roller to the nap. The valve that controls the pressure is located on either the roller handle or the tank.

(2) The roller should be uniformly loaded with paint to provide even application. Skipping will occur when paint is inadequately loaded onto the roller. However, tracking will occur if an excessive amount of paint is loaded onto the roller. Proper application pressure and technique should be used; initially, a zigzag overlapping application should be performed followed by a second coat applied at right angles to the first coat.

(3) Rollers are excellent for large, flat areas (e.g., tank sidewalls and tops, decks, ship hulls, walls, and ceilings) or whenever application does not require the skill needed for brush or spray application. Rollers also are recommended for use in windy conditions to eliminate excessive material loss and overspray. Rollers may be used for indoor application when overspray cannot be tolerated. Roller application on concrete cracks and voids is difficult because of the shape of the roller; therefore, a brush is recommended to work the coating into these areas. Roller application is more rapid than brush application but slower than spray application. A roller generally holds more coating than a brush, and it will provide a more satisfactory finish on smooth surfaces compared with rough or irregular surfaces. Brush or spray application is the preferred method for rough or irregular surfaces.

(4) Roller application characteristics for oil-based and waterborne coatings are excellent, and epoxies and urethanes are considered to be fair to good. Roller application characteristics for high solids coatings and inorganic zinc-rich coatings are considered poor. High performance coatings/linings for immersion are seldom applied by roller because of nonuniform thickness and wicking caused by roller nap residue.

c. Conventional spray application.

(1) Equipment. The conventional method of spraying relies on air for coating atomization. Jets of compressed air introduced into the stream of coating at the nozzle break the coating into tiny droplets that are carried to the surface by the current of air. The transfer efficiency is estimated to be 25 to 30 percent. A typical, conventional spray setup consists of: air compressor, oil and water extractor (separation), pressure feed tank (pressure pot) or paint pump, connecting hoses, and spray gun.

(a) Although the pot regulates both the air and fluid pressures fed to the spray gun, the air compressor generates the necessary pressure for these two flow operations. Air compressors can be of various types, and the size usually depends on the amount of air required in cubic feet per minute to operate the spray gun. Hoses must be properly sized to deliver the right amount of air volume and pressure to the spray gun. Approximately 275.6 to 413.4 kPa (40 to 60 psi) and 4.012 liters/sec (8.5 cfm) are needed to operate most production conventional spray guns with a medium viscosity coating such as latex paints, some lacquers, stains, sealers, alkyds, and conventional epoxies such as those specified in MIL-P-24441A.

(b) A separator should be in line, between the air compressor and the pressure pot, to prevent moisture and oil from reaching the coating. Moisture/oil separation for conventional spray should be considered mandatory. The use of properly sized and maintained moisture and oil separators helps ensure the quality of the finished product. In addition to adhesion defects, oil or moisture in the compressed air will mix with the coating during atomization and create voids, pinholes, and/or fisheyes in the applied film. A blotter test should be conducted at the spray gun prior to application to ensure a clean, dry supply of atomized air.

(c) The amount of fluid material delivered to the spray gun is controlled by the fluid pressure regulator of the feed tank pressure pot, which is a double regulator type. The pressure pot should be 19 or 38 liters (5 or 10 gallons) in size for most jobs. For the application of certain coatings such as zinc-rich coatings, the pot should be equipped with a mechanical agitator to keep the zinc-rich coating in suspension so the zinc does not settle on the bottom of the pot. If application stops and resumes after 15 minutes when spraying zinc-rich coatings, the entire length of the hose should be whipped to redisperse the coating in the line. If more than 1 hour has passed, all the coating in the line should be blown back into the pot and reagitated prior to use. The mixing and straining of paints are covered in Chapter 9. When coating tall structures, the pot should be kept at nearly the same level as the spray gun so lower pot pressures (55.12 to 82.68 kPa [8 to 12 psi]) can be used. Longer hoses and higher pot pressures are required when the pot is not at the work level. Excessive fluid pressure may cause the fluid stream to exit the fluid nozzle at a higher velocity than the air jets in the air nozzle can properly atomize. When the pot is not placed at or near the work level, the lower pot pressures can be maintained by using a fluid pump to pump the coating from the pot to the gun. These pumps are commonly used with hot spray setups.

(d) Two types of hoses are used in conventional spray coating: the air hose and the fluid hose. The air hose (supply line) from the compressor to the pot typically is red and usually is 19 to 25 mm (3/4 to 1 in.) i.d. The air hose from the pot to the spray gun also is red and should be 6.35- to 7.9-mm (1/4- to 5/16-in.) i.d. and as short as possible. The fluid hose usually is black and has a solvent-resistant liner. The inside diameter should be 7.9 to 9.5 mm (5/16 to 3/8 in.) for medium viscosity materials and also should be as short as possible. Hoses up to 12.7-mm (1/2-in.) i.d. are commonly used. Excessive hose length allows the solids to settle in the line prior to reaching the spray gun. This leads to clogging and the application of a nonhomogeneous film.

(2) Conventional hot spray. Conventional hot spray is similar to the standard conventional spray and is used during cooler temperatures to lower viscosity of the paint without having to add additional thinners. This reduction in paint viscosity is achieved by heating the coating to 66 to 71 °C (150 to 160 °F). The paint is hot when it leaves the spray gun, but the atomizing air cools the paint and evaporates the solvents. When the paint reaches the surface, it usually is only a few degrees warmer than if it was not heated. This process also provides less overspray because the material can be atomized at lower pressures. The hot spray process eliminates the need for additional thinners for application at colder temperatures. Excessive thinners reduce film buildup and cause solvent popping (craters) and orange peel. The equipment used in this process, in addition to the typical equipment, involves a heater and a hose from the heater to the spray gun; therefore, two material hoses are required. Hot spray application generally is restricted to the shop. Application without heating is used in the field because all types of paints can be used, including catalyzed paints. These catalyzed coatings cannot be used with the hot spray method because the heat will cause the coatings to set up in the equipment.

(3) Spray gun and adjustments. By varying the volume of air and coating at the spray gun, the amount of atomized coating can be regulated. The selection of a fluid nozzle and needle size is another way to regulate the amount of coating exiting the fluid nozzle. Excessive amounts of coating flowing through the fluid nozzle at low pressures (55.12 to 82.68 kPa [8 to 12 psi]) can be reduced by adjusting the material flow knob on the gun. Alternatively, a smaller fluid nozzle/needle combination may be used. Coating manufacturers normally recommend at least one set of sizes known to work for their product. The air nozzle cap can be for either internal mix or external mix. The internal mix involves mixing of the coating and air inside the spray nozzle. The external mix involves mixing of air and paint outside the nozzle between the horns. The most common method is the external mix because it produces a fine atomization and, if properly controlled, will provide the best quality finish. Internal mix nozzles do not provide the same quality finish as the external mix, and they are not recommended for fast-dry-type coatings (lacquer) because the coating tends to clog the nozzle tip, which results in distorted spray patterns. With both types, the atomized air breaks the streams into tiny paint droplets and provides the velocity for the coating to reach the surface. The pattern of the spray (round or oval) is determined primarily by the air adjustments on the gun and the air cap design. The needle valve regulates the amount of coating material that flows through the fluid nozzle. The distance that the needle can be withdrawn from the fluid nozzle is controlled by the fluid control knob on the back of the spray gun. The air valve is operated by the gun trigger. When the trigger is pulled, the air flow begins then the fluid flow follows. This is a major advantage of conventional (air) spray. By half-triggering the gun, the atomized air flows (without coating). This airstream is used to remove dust and loose debris from the surface prior to the coating application. The trigger is fully depressed to apply the coating.

(4) Spray application techniques.

(a) After the fluid and air pressures are properly adjusted, several basic spray techniques should be used to ensure the application of a consistent film of coating. A spray pattern 203.2 to 254 mm (8 to 10 in.) wide should be created by adjusting the air pattern control knob. The spray gun should be held at right angles to the work surface. “Arcing” the gun or flipping the wrist at each end of a pass results in a nonuniform coating film and excessive overspray.

(b) For large flat areas, each stroke should overlap the previous one by 50 percent. This produces a more uniform coating thickness. The stroke length may vary from 457.2 to 914.4 mm (18 to 36 in.), depending on the sprayer's arm length. To build a uniform coating thickness, a cross-hatch technique is usually used. The cross-hatch spray technique consists of a wet spray coat, using 50 percent overlap, followed by another full wet spray coat at right angles to the first.

(c) The spray gun trigger should be released at the end of each pass. At the beginning of a pass, the gun should be in motion prior to pulling back on the spray gun trigger and continued briefly after releasing the trigger at the end of the stroke. This produces a uniform, continuous film. Proper triggering also reduces coating loss; prevents heavy buildup of coating at corners, edges, and ends of strokes; eliminates buildup of fluid on the nozzle and tip; and prevents runs and sags at the start of each stroke.

(d) Proper spray techniques, which are necessary to produce a quality coating application, typically are acquired with experience. Quality coating application also depends on proper thinning of the coating, correct fluid pressure, and proper fluid nozzle size. Using proper techniques, a uniform coating thickness should be attained. Most types of paints, including epoxies and vinyls, can be effectively applied with a nozzle orifice size of 0.070 in. When spraying normal viscosity coatings, the orifice size generally should not exceed 0.070 in. because flooding may occur. Coal tar epoxies can be applied effectively using a 0.086-in. nozzle orifice.

(e) The proper gun-to-surface distance for a uniform wet film generally varies from 203.2 to 254 mm (8 to 10 in.) for conventional spray (compared to 12 to 18 in. for airless spray). If the spray gun is held too close to the surface, the gun must be readjusted or heavy coating application with sags and runs will occur. If the spray gun is held too far from the surface, dry spray will result and cause holidays or microscopic pores in the coating.

(f) Striping by spray also can be performed. A good practice is to apply an extra spray pass (stripe coat) prior to the first general spray coat not only on the edges but also on corners, interior angles, seams, crevices, junctions of joint members, rivets, weld lines, and similar irregular surfaces. This technique will assure adequate film buildup within complex, irregular areas. A full cross-hatch spray coat is applied after this striping.

(5) Advantages. Spray application of coatings is a highly efficient method of applying high performance coating systems to a substrate, and it results in a smoother, more uniform surface than obtained by brushing or rolling because these application methods tend to leave brush or stipple marks and result in irregular thicknesses. Large amounts of material can be applied in very short periods of time with spray application compared to brush and roller application. The ability to independently vary fluid and air gives conventional spray the ability to provide a wide selection of pattern shapes and coating wetness by infinitely varying the atomization at the gun. Conventional spray application has a high degree of versatility and relies on a combination of air caps and fluid nozzles available for different coatings. Spray gun triggering is more easily controlled for precise spraying of irregular shapes, corners, and pipes than with airless spray. The spray gun also can be used to blow off dust from the surface with compressed air prior to applying the coating. Conventional spraying provides a finer degree of atomization and a higher quality surface finish necessary for vinyl applications.

(6) Limitations. Because larger amounts of air are mixed with the coating during application using conventional spray, coating losses from “bounce back” or “overspray material” that miss the substrate can be high, depending on the configuration of the substrate. This bounce back effect makes coating corners and crevices difficult. Conventional spray also is slower than airless spray application.

(7) Coating types. Most industrial coating materials can be applied using a conventional spray. Fluid tips with various orifice sizes can be used effectively with epoxies, vinyls, and coal tar epoxies. Larger size tips can be selected for more viscous, mastic-type coatings. The coating manufacturer often recommends application equipment and will specify tip sizes for optimum application characteristics.

(8) Equipment care. When coating application is completed, all equipment components should be thoroughly cleaned. To properly care for the spray application equipment, the gun, hoses, and auxiliary equipment should be flushed thoroughly with an appropriate solvent after each use; otherwise, dried/cured coating materials will accumulate and cause the equipment to become inoperable. Thinner or a suitable solvent should be run through the tank, hose, and gun until the solvent runs clean with no visible coating color. All pressure should be released from the tank, line, and gun; and the gun should be disconnected from the line and disassembled. All components should be thoroughly cleaned with solvent, air blown, and reassembled for future use. The exterior surface of the gun should be wiped down with solvent-dampened rags.

(9) Safety considerations. Only recommended pressure and equipment should be used for conventional spray. Also, hose fittings should never be loosened while under pressure.

d. High volume-low pressure spraying. A high volume-low pressure (HVLP) setup consists of a high volume air source (turbine generator or compressed air), a material supply system, and an HVLP spray gun. The spray techniques associated with HVLP are closely compared to that of conventional spray and are a growing trend in coating application techniques. HVLP uses approximately the same volume of air as conventional spray, but lower pressures are used to atomize the fluid. Reducing air pressure at the nozzle effectively reduces the velocity of the airstream and atomized fluid. This reduces the bounce back of coating material from the surface, which results in a significantly higher transfer efficiency (55 to 70 percent) and application into recessed areas. The high transfer efficiency attained reduces material costs and waste, and an HVLP spray is easy to set up and simple to operate. However, HVLP spray has a lower production rate than airless spray; and some coatings are difficult to atomize, which can limit the use of HVLP spray.

e. Airless spray.

(1) Equipment. Airless spray equipment consists of a power source (an electric motor or air compressor), an air hose and siphon hose, a high pressure fluid pump with air regulator (if a compressor is used), a fluid filter, a high pressure fluid hose, and an airless spray gun with spray tip and safety tip extension. Each of these components will be discussed.

(a) The power source may consist of either an electric motor or an air compressor. An electric motor may be used to drive the fluid pump. The electric airless is a self-contained spray outfit mounted on wheels that operates on 120-V electrical power. Conversely, a remote air compressor can be used to drive the fluid pump. The larger, air-operated units are more commonly used on large USACE structures, and the smaller mobile units are used on small projects. The larger units are required to operate multiple pumps or other air-driven devices; they also provide the larger air supplies necessary to apply mastics and high-build coatings.

(b) A 12.7-mm (1/2-in.) air hose generally is used to deliver air from the compressor to the pump. The most common hose length is 50 ft. However, as hose length and pump size increase, a larger diameter hose should be used.

(c) The material siphon hose should be 12.7- to 19.05-mm (1/2- to 3/4-in.) i.d. to provide adequate fluid delivery. The hose must be resistant to the solvent and coating being used. A paint filter, often with the spray gun, should be used to prevent dirt or other contaminants—including improperly dispersed pigment (slugs)—from clogging the tip. In some instances the siphon hose is eliminated and the pump is immersed directly into the paint. This is known as a submersible airless pump.

(d) The fluid pump is the most important part of the hydraulic airless system. The fluid pump multiplies the air input pressure to deliver material at pressures up to 31,005 kPa (4,500 psi). A common airless pump has an output-to-input pressure ratio of 30:1; that is, for every pound of input pressure, the pump provides 30 lb of output pressure; therefore, this unit will deliver 20,670 kPa (3,000 lb/in.) of hydraulic pressure with 689 kPa (100 psi) of air pressure. Other pumps with a ratio of 45:1 provide pressures up to 31,005 kPa (4,500 psi) (689 kPa [100 psi] input). Air-operated pumps can produce material output ranging from 793.8 g (28 oz) per minute (one spray gun) up to 11.34 liters (3 gallons) per minute (three to four spray guns).

(e) A double-action, airless pump incorporates an air motor piston, which reciprocates by alternate application of air pressure on the top then the bottom of the piston. The air motor piston is connected directly to the fluid pump by a connecting rod. The fluid section, or pump, delivers fluid on both the up and down strokes.

(f) The high pressure fluid hose is manufactured to safely withstand high fluid operating pressures. The hose typically is constructed of vinyl-covered, reinforced nylon braid and can withstand pressures up to 31,005 kPa (4,500 psi); therefore, it is important not to bend the hose or restrict the material flow in any way or the hose may rupture. The hose also is constructed to resist strong solvents. A wire may be molded into the hose assembly to prevent a possible static electrical charge. The spray gun should be equipped with a high pressure swivel to accommodate any twisting action of the hose. The inside diameter of the hose should be at least 1/4 in. for most common coatings, except the viscous mastic-type coatings. The hose should not be longer than necessary; however, this is not as critical as for conventional spray. High pressure hose diameters up to 12.7 mm (1/2 in.) are used for more viscous mastic-type coatings.

(g) The airless spray gun is designed for use with high fluid pressures. The airless spray gun is similar to a conventional spray gun in appearance, but it has only a single hose for the fluid. The hose may be attached to the front of the spray gun or to the handle. The resulting airless spray (atomization) occurs when fluid is forced through the small orifice of the fluid tip at high pressures.

(2) Airless hot spray. An airless hot spray can be used to apply coatings at higher temperatures to reduce viscosity

without additional thinners. Equipment is similar to that used in the standard airless spray setup, except that a unit to heat the material is required.

(3) Tip size nomenclature. A variety of airless spray tips are available. Tip selection is based on the type of material being sprayed and the size of spray pattern desired. The tip orifice opening and the fan angle control the pattern size and fluid flow. There are no controls on the spray gun itself. Tip orifices vary in size to accommodate the viscosity of the coating being applied. Fan angles range from 10 degrees (101.6 mm [4 in.] spray width) to 95 degrees (431.8 mm [17 in.] spray width). For example, two nozzle tips with the same size orifice but with different spray angles will deliver the same amount of coating over a different area width. For example, two tips with an identical orifice size of 0.381 mm (0.015 in.) but different spray angles (10 and 40 degrees) will provide fan widths of 101.6 and 215.9 mm [4 and 8-1/2 in.], respectively, and will have identical flow rates of 0.0145 liters/sec (0.23 gallons per minute) at 13,780 kPa (2000 psi). Typically, when spraying a dam gate with an epoxy using a 0.381-mm (0.015-in.) orifice tip, fan angles ranging from 10 degrees (101.6 mm [4 in.]) to 50 degrees (254 mm [10 in.]) would be used. The quantity of sprayed coating is determined by the orifice size of the spray tip. A larger orifice results in more fluid being delivered at a faster speed; however, this leads to poorer atomization. Dual or adjustable tips can be used with airless spray equipment. Dual tips frequently are ball tips with two separate orifices. This feature provides the sprayer with the option of two different spray patterns: a narrow fan for smaller surfaces and a wide fan for production spraying. Adjustable tips vary the spray fan and, simultaneously, the tip orifice. The tip size increases as the fan width increases.

(4) Airless spray techniques. Application techniques for airless spray are similar to those for conventional spray, except that the spray gun should be held 304.8 to 457.2 mm (12 to 18 in.) from the surface as opposed to 203.2 to 254 mm (8 to 10 in.) for conventional spray because of the increase in the amount of coating being applied.

(5) Advantages. Airless spray equipment provides higher film buildup capabilities, greater surface penetration, and rapid coverage; it can handle products formulated with higher viscosity without the addition of large quantities of solvents; and it has low pressure loss when the pump is not at the same level as the actual spraying. Also, the single hose can be longer than a conventional sprayer and easier to handle. Mastic-type coatings such as coal tar epoxies (CTEs) are easily atomized by airless spray equipment. When spraying concrete and other masonry surfaces, airless spray efficiently and easily penetrates voids and general porous surfaces. Hydraulic pressure is used to force coating through an orifice in the spray nozzle. The high degree of pressure atomizes the coating as it is discharged through the spray nozzle without the need for atomized air. The coating beads into small droplets when released under these pressures (2,756 to 31,005 kPa [400 to 4,500 psi]) and results in a finely atomized spray and a transfer efficiency of 30 to 50 percent. Typical pressure for epoxies such as those specified in MIL-P-24441A are 12,402 to 17,225 kPa (1,800 to 2,500 psi), and 19,292 to 20,670 kPa (2,800 to 3,000 psi) for high solid epoxy mastics. Because of the high fluid pressure of airless spray, coatings can be applied more rapidly and at greater film buildup than with a conventional sprayer. The high pressure coating stream generated by an airless spray will penetrate cavities (which are typical on lightweight concrete blocks) and corners with little surface rebound.

(6) Limitations. Variances of the structure being painted in the field may create problems because of the difficulty in changing spray fan patterns and orifice openings in the field. For example, when spraying a large structure, a wide fan width will work well and provide the desired finish; however, when a complex design of a small surface area is encountered (e.g., back-to-back angles and other attachments) a small fan width is necessary to provide a quality finish. Because an airless sprayer does not atomize coatings as well as a conventional sprayer, it should not be used for detail or fine finish work. Additionally, if painters use excessive pressure or improper technique, solvent entrapment, voids, runs, sags, pinholes, and wrinkles may occur.

(7) Safety considerations. The spray gun should never be removed from the hose, or the tip from the gun, until the pressure from the pump and in the line has been released. High pressure through a small orifice can cause paint to penetrate the skin if pressed against the body; therefore, spray gun tips are equipped with trigger locks and tip guards. All high pressure airless systems should be sprayed and flushed in a well ventilated area. These systems also should be grounded to avoid dangerous static sparking, explosion, or fire when spraying or flushing the lines. (See Chapter 10 for a more detailed description of recommended safety practices.)

f. Air-assisted airless spray. The air-assisted airless sprayer was developed to combine some of the advantages of an airless sprayer (e.g., increased production, ability to reach into recesses and cavities without blow-back) and the advantages of a conventional sprayer (finer atomization). An air-assisted airless spray system consists of a spray gun, pump, hoses, and clean, compressed air of adequate pressure and volume. An air-assisted airless sprayer may be used with small containers or with 207.9-liter (55-gallon) drums using a submersible pump. Basically, an air-assisted airless spray gun combines the features found with both air and airless spray guns. A special fluid nozzle tip similar to that used with the atomization principle of the airless sprayer initiates atomization. Atomization is completed with the introduction of compressed air through the horns and face of an air cap (similar to a conventional spray air cap) that surrounds the airless tip. Without the compressed air, a coarsely atomized and poorly defined pattern would result. The compressed air emitted from the air cap provides a finely atomized coating, which approaches the quality of conventional spray atomization. Therefore, an air-assisted airless sprayer is ideally suited for fillers, glazes, lacquers, and polyurethanes. Medium to heavy consistency coatings require atomizing air pressure close to 68.9 kPa (10 psi). Light consistency coatings only require a few pounds per square inch of air pressure. Equipment maintenance and safety considerations are similar to those for standard airless and conventional spray equipment.

g. Plural component spray application.

(1) Perhaps the most complex of all spray application methods is plural component spraying. Basically, plural component spray mixes the individual components through careful metering at the spray gun or at the spray tip rather than premixing in the pressure pot. Plural component spray is commonly used for 100 percent solids coating materials and coating materials with limited potlife (such as epoxies).

(2) A plural component spray setup consists of six basic components: proportioning pump, mix manifold, mixer, spray gun, material supply containers, and solvent purge (flush) container. Plural component spray can be sprayed by conventional spray, airless spray, or air-assisted airless spray. The spray gun can be identical to those used with conventional sprayers, airless sprayers, or electrostatic sprayers. However, if the components are mixed at the gun, a special spray gun is required.

(3) Three systems are used to spray polyester materials, including a side catalyst injector system, an air injection system, and a split batch or double nozzle spray system. The side catalyst injector system mixes the polyester components externally in front of the spray gun. With an air injection system, a measured quantity of catalyst is injected into the atomizing air supply. The split batch or double nozzle spray gun system involves two quantities of equal volumes of premixed resin. The two quantities, in equal volumes, are delivered separately to the spray gun and are atomized in such a way that the individual quantities are intimately intermixed either externally or internally.

(4) Some types of plural component coating materials or adhesives that can be sprayed include polyesters, polyurethanes, vinyl esters, and epoxies. These materials may be mixed in varying ratios and viscosities.

(5) The application technique associated with plural component sprayers essentially is no different than that of conventional air or airless sprayers. However, the prespray procedures require a certain level of expertise in ensuring proper mixing of the individual components and equipment maintenance.

(6) Unlike conventional or airless sprayers, plural component sprayers combine separate fluids that are either mixed internally immediately preceding exit from the gun or externally; therefore, plural component spraying is the ideal system to use with coatings that have a short pot life (i.e., 30 minutes).

(7) A plural component spray setup uses complicated equipment compared to that used in conventional or airless sprayers. Because of the knowledge necessary to successfully apply coatings using plural component sprayers, a more experienced applicator generally is required.

(8) Whenever the equipment is stored, even for a short period of time, it must be cleaned thoroughly; different procedures may be required for overnight versus weekend storage. The system must be kept “wet” (filled with solvent) at all times to prevent the remaining material from setting up when it is exposed to the atmosphere. A solvent that is compatible with the resin materials should be used.

h. Electrostatic spray.

(1) There are several types of electrostatic spray systems, although the typical system involves hand-operated, electrostatic spray guns using air atomization, airless atomization, or air-assisted airless atomization. The equipment used to atomize the coating is similar to that of conventional, airless, or air-assisted spray setups; however, an electrostatic, high voltage supply also is used.

(2) Portable electrostatic spray units are used for coating applications to odd-shaped metal objects, such as wire fencing, angles, channels, cables, and piping. Electrostatic spray units impart an electrostatic charge to the coating, which causes the material to be attracted to a properly grounded object. The charged coating particles travel to the closest grounded object. The particles that miss the target wrap around to coat the opposite side of the target. Particles that strike the product and rebound are retracted to the surface.

(3) Virtually any atomized fluid is capable of accepting

an electrostatic charge. Careful consideration must be given to the type of electrostatic system being used. Each system demands paint formulation consideration acceptable to the process being used. Polar solvents (conductive) are required to improve the degree of atomization.

(4) The advantages to using electrostatic spray include: this method of coating application reduces coating material loss as it utilizes overspray by rebound; it reduces cleanup and maintenance time, increases production rates, and reduces the number of application steps caused by wrap-around; and it results in improved atomization.

(5) The uniformity of coverage will vary depending on the size and contour of the object. Because of the electric field, the exterior corners of items being coated often receive a heavier coating; the interior corners are difficult to coat. Also, coating materials may require special formulation, such as adding special solvents to the coating, to enable it to accept the charge. The item(s) to be sprayed must be grounded at all times. Electrostatic spray guns are limited to the amount of fluid they can efficiently charge in a given period of time. Observing safe operating procedures is extremely important because of spark potential.